



EP INTERGROUP ON CLIMATE CHANGE, BIODIVERSITY AND SUSTAINABLE DEVELOPMENT

REPORT

Seminar

Increased Selectivity versus Balanced Harvest: How do we best meet ecosystem objectives in fisheries?

Tuesday 8 November 2012
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Chaired by **MEP Struan Stevenson**, Chair of the EP Intergroup "*Climate Change, Biodiversity and Sustainable Development*"



Opening session

Welcoming remarks by MEP Struan Stevenson, Chair of the Intergroup

MEP Struan Stevenson introduced the scientists present in the panel to discuss a revolutionary approach of fisheries management.

Introduction by Dr. Serge M. Garcia, Chair of IUCN/CEM/FEG

Management of fisheries has never been easy. The ecosystem approach has been adopted by the CBD, FAO and is reflected in the CFP documents. The key issues are: (1) how much can we fish? And (2) what sort of fish can we fish and must avoid to fish? In general, management regulates selectivity at gear level, but fishermen in each fleet decide where and when to fish and markets decide what to buy. What results is selectivity at the ecosystem level, the one that Balanced Harvest (BH) is concerned with. But nature has its own selectivity measures, which we are not familiar with. Governments have taken hundreds of measures on mesh sizes etc. to regulate selectivity of single fisheries but have hardly ever checked the cumulative outcome of these measures at ecosystem level. The problem is that the Ecosystem Approach to Fisheries and conservation agreed by governments imply that harvesting is undertaken “while maintaining ecosystem structure and functioning”. The single-species approach we followed for decades, knowing its limitations, reflected our inability to model ecosystems and to handle more complex management strategies. We now have the necessary tools to model ecosystems and the effects of fishing and we have starting realizing that the conventional selectivity approach might not be appropriate in achieving both fisheries and conservation objectives. Time has come for governments to check back if what they are doing matches their commitments and adjust their strategies as appropriate.

Presentations

Balanced harvest: can it reconcile fisheries and conservation objectives?

Dr. Jeppe Kolding, Member of IUCN/CEM/FEG

It is important to remember that fish eat fish and that this affects the consequences of selectivity measures. Managers must try to maintain biomass levels that can produce MSY and at the same time, they are asked to maintain the ecosystem structure and function in order to continue obtaining the goods and services it provides. These two objectives need to be reconciled in the ecosystem approach. The 2008 Marine Strategy Framework Directive, in



its principles and guidance, embraces already the balanced harvest approach and is therefore not new for the EU. But the implementation of the vision may need to progress further.

At the gear/fishery level, the selectivity reflects the way fishers target only part of the resource, selecting species and sizes. At ecosystem level, it is the result of how the fisheries work in practice. In a conventional approach, managers usually consider selectivity at gear/vessel level, imposing gear types, mesh sizes, fish to be avoided, closed areas, etc. Up to now, this approach has ignored the cascading effects of selectivity measures due to the trophic relations between ecosystem components.

If discards are considered a problem, an intuitive way to avoid/reduce them is to be more selective. Indeed, one practical element in a balanced harvest implementation would be to avoid discards and land everything managing the whole removals at ecosystem level.

The conventional management paradigms (the Yield per recruit and MSY paradigm) are based on the combination of growth and mortality and on the concept of critical age. However, this paradigm “forgets” that fish need food to grow. Growth is not free and man is not the only predator. To grow one kilo more, a fish needs to eat about 4-5 kilos of seafood, and this consists often of small fish including very often its own progeny. Under the Yield per recruit paradigm fishermen have been told to increase mesh sizes to improve the long-term yields but when feeding needs are taken into account, the ends results of selectivity and predation tend to be very different and counter-intuitive, leading to unexpected results, and often a decrease in long-term yields. The dolphin-free tuna campaigns, for example, which successfully led to a large reduction of dolphin deaths in tuna fishing, also led to unexpected developments in the fisheries that resulted to a very significant mortality on a much larger range of fish species and higher discards rates.

The trophic chain is a central issue. Fish are evolutionary adapted to die young. Cods have millions of eggs and most of them are never intended in nature to survive to a great age. Around 99% of the fish die when they are young, by being eaten by others long before they reach the critical age we aim at for capture. When it reaches 5 to 10 years of age, it has grown out of the predator window and its survival rate improves dramatically. Under these conditions it is advantageous for the fish to grow big. That advantage disappears if they are heavily decimated by fishing when reaching reproduction age/size. Indeed, individual growth and age-at-maturity has been shown to slow down if only large sizes are targeted. It has also been shown that higher yields can be obtained by targeting small or young fish, which have higher productivity.

Selectively picking some large individuals and species from an ecosystem has a market-logic but is has very inconvenient biological properties (changes growth and reproduction) and ecological implications (changes the ecosystem structure and possibly functions, resilience, variability, etc.). On the contrary, it is intuitively understandable and confirmed by a very large range of models that fishing all the usable elements of the food chain in an ecosystem in proportion to their productivity (e.g. their natural mortality) (perhaps including plankton



at some stage) the ecosystem structure (in terms of size spectrum and relative abundance, for example) remains intact, as we will have taken our 'tax' or share as a constant proportion of the productivity of the resource components. Analyses undertaken in the Norwegian/Barents Sea and the North Sea show the first seem to have been exploited in a rather balanced manner (the present catches are roughly in correspondence with the productivity of the components, except for the highest and lowest trophic levels and few species are overexploited) while the North Sea fisheries have a deeply modified that spectrum, depleting large species and sizes and under-exploiting smaller ones at the bottom of the pyramid.

The impacts of selectivity on marine ecosystems: results from dynamic size spectra

Prof. Richard Law, University of York, UK

There should be some concerns about the direction the CFP is taking us. During the 13th to 15th centuries, cod sizes averaged 80 to 100 cm in the landed catch in NE England. Big fish! Last year about 98% of the cod caught in the North Sea were was under this size and 60% of these fish were discarded anyway. Looking at the abundance of fish by body size rather than at any individual species, we find that taking out the large sizes modifies the structure and dynamics of the trophic chain, truncating the chains at large body size and increasing variability in abundance over time.

Nonetheless, the reaction to the discards "debacle" is to make our fishing even more selective. Models and empirical observations indicate that this may be the wrong approach. Fast phenotypic (possibly genetic) change can take place because of our fishing methods. When putting in place selective fishery policies that will be in place for a decade, bear in mind that, within that small time frame, they can cause a reduction in body length for fish of several cm. For example, Icelandic haddock decreased in length by about 4 cm at age 6 years, consistent with selective fishing.

Balanced harvesting is harvesting the biodiversity elements in proportion of their productivity. The advantage it brings for nature (better system structure and stability) and the fisheries (better yield, stability, diversity) results from the way in which the biomass flows through size compartments. Modeling the process shows that, when fish are small, biomass moves rapidly through size compartments and hence productivity is high. The opposite happens when fish are large. Therefore, there seem to be advantages in taking more catch from smaller fish while protecting Big Old Fat Fecund Female Fish (BOFFFFs). There should be no discards under balanced harvesting (all that is taken is catch and all should be landed) but care will still be needed not to take more than productivity allows. What is counter-intuitive is that, contrary to what the conventional (Beverton and Holt) paradigm, these models indicate that yields can actually increase substantially under balanced harvesting.



Introduction on Policy and management implications

Serge Garcia, IUCN/CEM/FEG

The policy and management implications of Balanced Harvest (BH) are significant. Comprehensive ecosystem modeling of numerous ecosystems of the world using different models have indicated that with concentrated fishing (exploiting a limited range of sizes and species) will make the managing task a lot more risky than widespread fishing (balanced harvest) and would lead to more sustainable and higher yields, less risk of collapse of some components, more sustained yields, etc. The sorts of things (very briefly) that we should consider are, *inter alia*:

- Building management strategies around the concept of “cumulative selectivity”, at ecosystem level, explicitly;
- Evaluating the performance of the conventional strategies in place;
- Decide on what ecosystem “structure” is to be kept in balance and used to establish the removal strategy (trophic levels, sizes, species assemblages (functional groups)?
- Consider adding a layer of ecosystem-based strategic (long time) regulations to the existing single-species (shorter time) regulations while improving their “ecosystemic” perspective.
- Increase focus on diversity and diversification of harvest. Better distribute the impact across species and sizes according to productivity. This implies to critically examine management strategies that tend to increase target specialization and selectivity, looking for better ways to balance overall pressure across the wider spectrum of species and sizes.
- Develop incentives to convince fishers to broaden harvest diversity when appropriate (e.g. for least preferred species) and promote adequate transformation of the species concerned to increase market acceptance

How to combine all these considerations in a coherent “balanced harvest” management strategy is not yet totally clear and will vary between places, types of fisheries, etc. We have already a large selection of selectivity-control management tools and can make better use of incentives, ecosystem taxes, ecolabelling, and novel food technology.

Policies towards BH are only efficient if overfishing is eliminated (it will need to be redefined at ecosystem level). So, recovery plans must be part of balanced harvest under overfishing conditions.



Panel discussion

Ernesto Peñas Lado, Director, DG MARE, European Commission

A number of key questions emerge from this debate. How do we define and reach MSY in mixed fisheries? How does selectivity (how to fish) interact with fishing pressure (how much to fish)? Fishing is an economic activity, so whatever we suggest should allow our fishermen to go out and make money (in a sustainable manner). There is a direct correlation between fish size and fish prices, so balanced harvest might affect profits. If it appears to be uneconomical, it will simply not be enforceable. Balanced harvest can also be counter-intuitive. Where there is extreme over-exploitation (as in the Mediterranean), would balanced harvest work? Are we sure that effects observed in the empirical evidence shown in the Norwegian Sea are due to balanced harvest strategies and not to other factors such as discards bans.

Carl O'Brien (ICES)

In the last decades, we have been constantly asked and trying to provide “sticking plasters” to mind over-exploited stocks using conventional selectivity. We know that it is not satisfactory. In the conventional paradigm, we treat by-catch as a nuisance while Balanced Harvest treats it as part of the catch. The conventional paradigm focuses on what landing can be allowed. Balanced Harvest focuses on what we want to leave in the ocean. The models, we use at the moment to support management strategies are not fit for this purpose. But ICES has the capacity to face this challenge if a demand in that direction was formally expressed by EU.

Jeppe Kolding, IUCN/CEM/FEG

In relation to the question from E. Peñas Lado regarding the real causal factors of the Barents Sea observations, it can be stressed that the number of fishers in Norway has been halved during the last two decades. At the same time the Barents Sea has warmed up vastly increasing the productivity and areas of distribution. The combined results and a very precautionary approach, has resulted in increasing biomass for nearly all the Norwegian stocks. Presently we have very high spawning stock biomass for cod and herring, to the point that there seem to be not enough food left for them. Herring migrations have been disrupted for some components, and large mortalities are occurring despite low fishing rates. We are facing a possible collapse due to starvation, according to some scientists. Fishermen – and some scientists - demand higher quotas, but we have rules that restrict this to 10% increase per year. We also observe that there are no small cods to be found in Barents Sea (perhaps due to predation by the cannibalistic effect of the exceptionally high adult stock). There are increasing concerns that we may have been under-fishing in Norway. The discards ban policy and by-catch rules have created problems. At present an interesting



court case is on-going in Norway, where a capelin fisher is charged for having caught approximately 600 kg of cod in a 500 ton purse catch of capelin. It is practically impossible to catch capelin without cod by-catch and if a capelin fisherman has no quota for cod he is practically forced to discard to avoid being heavily fined. Mutually inconsistent rules and regulations that are impossible to practice will indirectly cause fishers to still discard in Norway!

The question is therefore a valid one. The numerous factors at play in Nature make it difficult to empirically prove or disprove the impacts of Balanced Harvest in particular situations. But the point really is that if an ecosystem seems to be roughly in balance (as the Barents Sea a decade ago), we need to try to maintain in in that state. If it appears to be out of balance (as in the North Sea, or the recent worrying observations from the Barents Sea) corrective action is needed. The likely impact of that action might be cautiously forecasted. The real impact will depend on Nature. The interaction of Nature with human “corrective action” is normal and the adaptive approach has been conceived exactly for that purpose. And by the way, this uncertainty has been affecting also the present scientific advice and management system for decades.

Richard Law, University of York, UK

Regarding the question of E. Peñas Lado about the applicability of Balanced Harvest in a heavily overfished area like the Mediterranean, applying balanced harvesting would require reductions in fishing pressure on large individuals and might help stock recovery.

Serge Garcia, IUCN/CEM/FEG

Regarding the remark made by E. Peñas Lado on the fact that Balanced Harvest can be counter-intuitive. For experts in population and ecosystem dynamics, however, the results are intuitively correct, and comforted by models. Applying “Balanced Harvest” in many European waters requires a reduction of fishing pressure but modeling indicates that yields may be higher overall (even though that has to be verified in each specific situation). Fishermen will understand and probably like this perspective even though they might be worried about the practical implementation. The terrestrial analogy is that in hunting reserves, hunters have been confronted by scientists for a number of years for the fact that hunting only large trophy species was damaging the wildlife genetics and productivity but they have resisted the idea to target also younger animals because trophies are a main objective of large mammals hunting, not ecosystem stability.

Perhaps more that the concept itself, the key issue is the transition from the conventional to the new approach and, as the concept will be further confirmed, we will need to find smooth implementable pathways to put it in practice.



Regarding the interference caused by natural perturbations, ecosystem fluctuations will, as always, be a disturbing element in the assessments but they will need to be explicitly “factored in”. The fact that the well-known large centennial oscillations of Bluefin tuna are not yet integrated in tuna management strategic analysis, for example, is disturbing.

Regarding the key issue of uncertainty, the concept of Balanced Harvest could be considered a “*Focus Imaginarius*” (sensu I. Kant) in the sense of something we (managers, scientists, industry and society as a whole) all agree to aim at even if it is difficult, simply because it points us in the right direction: maintaining ecosystem structure and function. Implementing it will call for an additional layer of ecosystem-related objectives and science on what we have now, stock-by-stock, considering the impacts of all the fleets operating on the ecosystem (or the trophosystem). BH is probably not readily applicable in the coming CFP as it still requires the building of a more complete science and larger agreement on its meaning and operational implications. However, the policy could already include elements leading to it and possibly implementing elements of it where possible. ICES could be asked to start working on this issue with the large capacity it has, preparing and guiding the change.

It would be wrong to interpret “balanced harvesting” as meaning “unselective fishing” because each fisherman and each type of exploitation will necessarily be selective (in relation to the ecosystem) because of its localization (e.g. in depth, distance from the coast, biotope) or the market it addresses (e.g. species and sizes). But the total, cumulative, selectivity, assessed at the level of the trophosystem should aim at maintaining the ecosystem structure, as agreed by States at the highest level.

Exchange of views with the audience

Andrew Brown, Scottish Permanent Representation

Is the fisheries-induced evolution a genetic change or is it a phenotypic issue? Can we rebalance the slope?

Dr. Law: looking at the genetic changes had not been a priority in fisheries research until now and some empirical grounding is missing for this. More effort should be put into this, especially because some changes will be difficult to reverse by changing the fishing patterns.

Dr. Garcia. The issue of the phenotypic/genetic change in fish has been discussed at the Nagoya workshop. Experts said that there is obvious phenotypic modification in many stocks. On whether these modifications are genetic or not, the experts said that some elements show that changes are most probably genetic but that this assertion cannot be generalized without more data. However, the question could be the opposite: are we sure that the impact we are having is reversible? And if not, what should we do?

Kenneth Patterson, European Commission



Balanced Harvest proposes to catch resources in proportion to their natural mortality in order to maintain the size profile in the exploited ecosystem. Which profile should be used as reference? The present profile (distorted by past fishing) or the pristine one (unknown)? Maintaining the present one would be maintaining the status quo which may not be optimal in terms of ecosystem structure and/or yield. On the other hand, determining the profile before exploitation is usually impossible as there are few historical data.

Prof. Law replied that this is indeed a problem and is a topic for current research, where various options can be explored by mathematical modeling.

Dr. Kolding reminded the participants that deciding “what ecosystem we want” is a societal issue. It is therefore up to stakeholders to decide what profile is considered appropriate and use it as the reference structure for management. Science can bring the tools for this determination but cannot bring the answer. Balanced harvest has implications also for conservation of some emblematic animals. If we really intend to fulfill the States commitment to maintain ecosystem structure, then marine mammals would also need to be caught in rather small numbers as their productivity is very low but they are part of the trophic chain and predators of other fish and invertebrates. The key question, however, is how we want our ecosystems to look like. This is not just a scientific question, but it is up to society to decide for each ecosystem how many marine mammals they may want to harvest and want to keep – just like we do on land in our wildlife management. The reference ecosystem profile is for society to define and once agreed, balanced harvest may help maintaining it better than the present strategies.

Dr. Kolding stressed that the “elephant in the room” when we talk about the ecosystem-approach is what do we want our ecosystem to look like? I come from Denmark and this country had turned into a garden. There are no big predators left. The society has to decide which is the ecosystem it wants and if its ecosystem is a bad ecosystem. Do we want elephants in our garden? How we want our aquatic garden to look like? Do we want it to look like “pristine” or do we want to harvest it? This discussion needs to take place.

Dr. Garcia stressed that the concept of “pristine structure” had two dimensions: abundance of each component and overall “shape” of the biodiversity assemblage (e.g. in species and sizes). BH proposes to maintain the structure while reducing the biomass (for food provisioning services). We cannot go back to the pristine structure of pre-historical times, when nobody was fishing, even if we could simulate it with all its likely natural fluctuations. However, the parties to the CBD have agreed that the shape of this structure should be maintained, and therefore something needs to be done. The target ecosystem structure used for management will “simply” need to be agreed. It should be the ecosystem we would like to have in the future (with its desired properties and its outcomes) and not an unknown and probably unreachable image of what it was in the past. Such a reference state can be agreed and aimed at. Scientists have criticized MSY for 40 years. Managers have attempted to aim at this elusive concept for decades and we know that corresponding removals are often already too high, generating strong oscillations that even industry finds regrettable.



Yet we still embrace it in legislation. The status quo is not an option. And a progressive evolution to the Ecosystem Approach adopted more than a decade ago is needed and apparently possible.

Bruce Chapman, ACP Secretariat

Purse-seine fishery is considered as a “clean” fishery for skipjack. You catch almost totally skipjack but there is a by-catch of other fish (other tuna species and pelagic). How would a balanced fishery for tuna look like?

Dr. Garcia agreed that the question on tuna fisheries was an interesting one, indeed, because these fisheries are very selective and still catch sharks, turtles, dolphins and a number of pelagic species. With the increase in the use of Fish Aggregating Devices (FADs), in part to reduce dolphin by-catch, discards in other species have increased rapidly. A large ocean ecosystem like the “tuna ecosystem”, in which we are only targeting a few high predator species, is an extreme test for the BH implementation. The question was debated in a recent symposium on **Mitigating impacts of fishing on pelagic ecosystems** in Montpellier (15-18 October 2012). The concept was rather well received but much more thinking and modeling as well as interaction with industry will be needed before we have a clear position on these systems. Will we be able to keep them in balance? Or will we have to accept that it is impossible? What impact is the society ready to accept? Again, this is a societal choice, not a scientific one.

Ernesto Peñas Lado, Director, DG MARE, European Commission

On whether we have a desire of how our aquatic garden should look like, Mr. Peñas Lado said that the European marine environment is a bit like the Danish landscape. There is hardly any bit of sea-bottom that has never been trawled. However, there are clear objectives, set in one of the descriptors of the Marine Strategy Framework Directive. This descriptor says that the EU should obtain ecosystem with a balance of the different species present in it. This objective raises many questions. Amongst those questions, there is the one of “which balance do we want?”. The Pristine structure is unknown; the current one is one of a heavily exploited ecosystem. Decision-makers must decide which balance they want to reach. There seems to be certain logic in Balanced Harvest as a necessary complement to this approach? For example, could the discard ban be an instrument to implement a certain notion of balanced harvesting).

Serge Garcia, IUCN/CEM/FEG

The shape of the ecosystem is a decision for each society. Even when CBD says that the structure and the functioning of the ecosystem shouldn't be changed, it does not say which the departure point is. Models could inform on how the ecosystem might have looked in the absence of fishing or may look if fishing activities were stopped. However, Dr. Garcia asked if it would be reasonable to take this as a reference target for BH.



It is to the State or to a group of states to decide which reference profile they wish to aim at and possibly maintain. The law of the Sea says it should be MSY. However, scientists have been criticizing MSY for decades because it is too dangerous. “Stock oscillations at MSY levels are already important, disturbing management and industry. This level may not be very precautionary. Somehow, the society must choose the ecosystem it would like, not only in terms of structure, but also in terms of stability. To be more profitable, the industry needs resources stability and not only higher stocks.

Kenneth Patterson, European Commission

If you try not to change the shape, you should avoid catching small fish.

Bjorn Stockhausen, Seas at Risk:

Your theory proposes to fish everything. Are you also taking into consideration zoo plankton in the model? They have an ecosystem function as well. Also, its consumption has to be promoted to the consumers. Compared to today, would balanced harvest mean lower or higher TACs? What is the time frame for this?

Prof. Law: To maintain an exploited size spectrum with a slope approximately parallel to an unexploited one, calculations suggest that fishing mortality rates would need to be set proportional to the relative growth rates. There was a point, in my presentation, about the possibility of doubling the harvest through balance harvesting. These estimations should be made carefully. This idea is only in its early days and further studies should be carried on.

Dr. Kolding: Fishermen say they would be competing with the marine mammals if they had to fish krill. However, if you want to implement a balance harvesting, you have to catch big mammals as well according to their productivity, which is of course much lower than the krill one. However, our experience in Africa showed that by diversifying the fishing patterns, African small-scale fishers get very high yields.

Dr. Garcia : The debate on using zooplankton to whales is essential for this debate. The reasoning is the same when we look at the extremes. How much protection we want is a society choice. However, there is a problem of decision-making in the international institutions. In many cases, civil servants from the same States take contradictory decisions in international fisheries arenas than in environmental ones. The IUCN/CEM/FEG thinks European Union scientists and decision-makers should look at Balance Harvest. It might not be the solution to everything but it seems to offer a better way to lower our impact on the ecosystem while maintaining or improving food production. What is important is the process, not the solution. It must be a participative process. The institutions already exist. Also, the industry should be participating in the discussions. It will probably take a decade to have a final position on BH.



Closing remarks

Richard Law, University of York, UK

This discussion was helpful to raise some of the issues dealing with selectivity and the potential dangers of it.

Serge Garcia, IUCN/CEM/FEG

The question is not to go away from selectivity. There is no way to make every fisherman catch everything on their vessels. Every vessel will continue to be selective. Even the market is selective. The question is to make sure that the total selection in the ecosystem is balanced. Also, there has to be means to be reactive: if a group of predators explodes, quotas will have to be raised for this species. Europe has an incredible advantage and this is ICES. They will have to look at the ecosystem level so as to give advice for the quota the next 10 years (not annual advices anymore). Industry would be very interested by these data too.

Ernesto Peñas Lado, Director, DG MARE, European Commission

I agree with the idea that a *focus imaginarius* is needed. Decisions on the CFP have been focused on short-term perspectives for too long. We all know that MSY is a distant target and a moving target. What is important is that we fix ourselves a long-term objective, no matter how blurry it is. This is an extremely interesting notion for how to achieve MSY in mixed fisheries. The Commission will have to look at that more deeply. Catching small fish is not something against the Commission's religion. The albacore fishery is composed by 80% of juveniles and yet it is highly sustainable. On the market issue, there are some areas where juveniles are lucrative. However, the current selectivity in EU fisheries is focusing on big fish only and a much more nuanced pattern is needed.

Carl O'Brien (ICES)

The questions managers give us are focused on the short term. ICES would be pleased to receive questions about these new approaches.

Jeppe Kolding, IUCN/CEM/FEG

Two months ago, a Norwegian think tank released a study on "Productive oceans in 2050". The only strategic view mentioned in that report was FEG's "Science" paper on balanced harvest. Norwegians have taken this up and are working very seriously on it.

MEP Struan Stevenson, Chair of the Intergroup

The state of EU fish stocks is concerning. EU bureaucrats are blamed for their management and it is often said that the EU should devolve its powers to Member States. However, this new approach of management could also be a way to reach MSY levels.